

## **Psychology of Learning**

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**Lecture – 17**

**Thinking and Cognition (Contd.)**

Welcome back to this new NPTEL course on the Psychology of Learning. So, in the last class, we were discussing strategic thinking skills, strategic thinking processes and mechanisms. So, to continue with that topic only, which is thinking and cognition, now, we will be discussing a new concept of thinking, which is cognitive architecture.

Why I want to give this slide here because it is a kind of, you know, example of cognitive architecture that I am putting here. Actually, whatever about cognitive architecture has been mentioned in the slide is actually the computational representation of some cognitive architecture that takes place in cognitive science or computer sciences. I am just giving it as an example. So, what is the cognitive architecture actually? Like why do we need to understand it? What is the design of the brain that makes the mind function properly? So, what are the components? Yes, we know that there are the basic components of brain. There are different internal biological features, lobes, different structures are there.

So, within the brain what are different features? What constructs are there, and how do they function? So, in order to analyze this, in order to just clarify it, I am just putting this cognitive architecture. But in psychology very often we do not use cognitive architecture, but I have just intentionally put it here to make you understand how the brain functions actually. To understand what is the structure of the brain, what are the different components and activities and how this cognitive architecture of the brain makes it function and how the mind functions and operates. Just to make sense of the brain as a computer and how the brain function is very much similar to the computer, this architecture is being designed. Just to give you that kind of impression, I am just putting it. So, here is a computational model, a cognitive structure. again You know when we talk about the human behavior , behavioral selection and performance system, we talk in computational languages. So, similarly in this cognitive model, we will discuss.

It has memories. Like human memory, it has a working memory, buffers, long-term memory, semantic memory, episodic memory, activation mechanism -all these functionings are also there just like the human memory system. Similarly, learning takes place in a symbolic way, in a statistical way in computational science. In computers, it takes place in algorithms, in formulas, in statistical methods, in analytical methods. Similarly, these are the mechanisms of computer architecture. So, similarly, human factor limitations like when you know when a computer interfaces with the human user's, etcetera what are the perceptual-motor parameters.

So, how are individual differences taken care of? How strategies and knowledge capacity of the parameters are taken care of. So, this is the cognitive architecture of a computational model. So, they have also mentioned the environment, input, output, and different mechanisms. Similarly, the human brain also has the structure of all these components, and it also functions in a similar way. So, similar way, you can say cognitive architecture is actually the structure

that creates the mind that how the brain functions and how the brain functions in a meaningful way.

So, when it the brain functions in a meaningful way when we are getting some result means the mind functions the mind happens how the brain architecture the brain structures stimulates or activates the mind to perform to act in a certain way ok. So, that is the thing. So, that is actually the cognitive architecture as you can see it is a demo its picture of given here is actually it is a simplified taxonomy of a cognitive architecture from the computer science actually. So, here also as they have the symbolic learning process emergent things they have the components, but similar components the learning component the memory component. So, these things are also are there.

So, similarly our human brain is just like the computer and it functions in that way. So, that is why we the we need to understand that the brain has also brain is human brain is also having an architecture and which is you know which is which is which is not very clear to us or the psychologist, but it may be very clear might be very clear to the brain neuroscientist they can better explain it how the brain functions. So, here the brain architecture the cognitive architecture of the brain is required because it we can know that it actually it manipulates or it activates the human mind to behave in a certain way ok. So, how these structures work with each other how the different lobes different parts of the brain they work together and they use the knowledge and the skills they create and manage intelligent behavior and they just get manifested in different kinds of you know outcomes how the process information and how the processes of information are being carried out carried out from one place to another place and how the analysis is being taking place with analyze target activity that is being modeled all these things like the like the computer has a software similarly brain in the within the brain the cognitive architecture actually actually actually you know is a software is a brain is also acts as a executable software which from time to time it also codes different programs it plans certain things. So, the cognitive architecture of the computer is very much similar that it is it is a you can say it is very similar to the how the brain functions how what is the brains architecture, but yes of course, this brain structure the architecture is very different from individual to individual would be individual depending on the you know all kinds of you know components and the biological things and the neural network all kinds of features.

So, but however, this cognitive architecture as it is used in brain science in computer science is completely different in psychology theories, but just to have an idea that how the brain functions and the brain creates the mind and the mind function in these things this is the way. So, we are that is why we are just analyzing the cognitive processes, but behind all these cognitive processes activities the cognitive architecture of the brain actually functions. So, now, so, again so, here in psychology we can say of we have the according as per the understanding as per our understanding of the how the brain functions different theories and researchers they have developed the cognitive hierarchy. That means, hierarchy means cognitive cognition is a continuous process and starts from the birth of the human life to the till the end of the thing and with learning with experience with development process with age also it enhances our skills abilities primarily through learning maturity we enhances our skills competencies abilities etcetera. So, how these cognitive abilities and processes are being organized in a hierarchical way in a structure hierarchical way that is from the simple to complex in an inductive way that we will be just discussing and different theories have also given their different their ideas they put the different models of cognitive hierarchy as per their research.

Like this is the standard like as you can see this is the standard cognitive hierarchy model starting from the information processing speed. Like for example, whenever we interact we interact we face a stimulus and we start to react it. So, that is respond so, stimulus and response over the stimulus is object and we are when by looking at it we respond either remaining being just looking it observing it by reacting it responding. So, what is what is what would be our response pattern to that stimulus that is also unique and how quickly that is the here that is why processing information processing speed. All these you know all these squeezes all these squeezes speed speed test speed mcq speed quiz test time bound speed test actually say that how quickly you can react to.

So, all these you know all these 'Kon Banega Crorepati' questions etcetera how quickly you respond to that answer that is speed of the processing here it measures the speed of how quickly and accurately correctly your your answer if that is it it actually measures your response or reaction time. So, that is the quickly reaction time that is the speed of information processing to begin with what is the speed of information processing then how much attention and concentration we are giving selective attention concentration thereafter concentration also perception is also there then from perception it is working memory how do we process the information then how do we retain it then memory in the long term then all the executive functions etcetera. Similar all this this is the this is the hierarchy of the cognition that cognitive activity. Similarly another person they have also given the basic as attention drive arousal etcetera information processing in this way. So, every researcher they have given their own model of cognitive hierarchy or level of difficulty difficulty level of difficulty in processing abilities cognitive abilities skills.

So, similarly so, different instructional theories or educational theories instructional theories also they have developed the different instruction models theoretical models on basis of which they have propagated advocated that the learning and instructional designs and the lesson plans at the different stages from school level to secondary to college level how these instructional lessons these are instructions lessons and the curriculum should be designed as per the cognitive hierarchy or the difficulty level of the task or difficulty level or the developmental stages of human cognition. So, out of so, many theories are there, but out of which we will be discussing Benjamin Bloom's taxonomy taxonomy of learning objectives. So, his theory is very very famous and it has been extensively used not just in education in formal education, but also in workplace education in training and development everywhere this Benjamin Bloom's taxonomy of learning objectives for three different domains and these are being extensively used. As you can see here the Bloom's taxonomy this is the revised taxonomy taxonomy that is updated. Initially there was a little bit change we will discuss it first thing is that first in the basic level is that when we learn something we try to remember it is a basic that means, to begin with the reaction time attention etcetera perception etcetera then we try to remember it memorizes.

So, first stage is the remembering the thing trying to understanding understand the whole things meaning of that concept ideas inherent ideas. So, that is the understanding your comprehension then third level of learning objectives is that application that once we have understood the whole concept and ideas etcetera how we are going to utilize this information a new situation in our real life situation that is application of knowledge in different context. Then after that then we try to analyze the analyze that means, for the further analyze what are the connections how to that means, what are the connections that is there in between the ideas what are the components what are the different different things how that how to compare and contrast all these different components and how to distinguish. So, analyzing all the

components sub components within a particular idea or the concept then thereafter after analyzing all these things then we have to evaluate it we have to evaluate in terms of its in terms of evaluate in terms of its strengths weaknesses you usability utility sustainability you know merits demerits all kinds all kinds of evaluation that can be made with that concept whether it is a mechanical concept technical concept mathematical concept social concept whatever may be the thing. So, this is the next is the evaluate then again in this after evaluation.

So, every individual learner primarily it is being used in our constructive learning theories primarily constructive learning theory which says that and states that you know every learner is a constructor of the constructive learner in the sense that not it is not just about the passively mugging of the learn mugging up or just feeding the information, but also analyzing, evaluating all these information may be that some information he may reject it some information he may unlearn it is reject it and may be that after evaluation we can think of some new ideas and reassemble the whole things in a new learning component construct. So, it is a unconstrained unlearning constructing reconstructing the whole ideas of the set of information. So, that also creates a new learning altogether. So, learning concepts learning domain learning that also it creates a new knowledge also. So, that is the constructive knowledge then after evaluation then it creates it creates the new products new ideas new original work.

So, the creativity or creative thinking whatever we say is the highest level of cognitive component cognitive processes where after going through all these processes the learner creates something new. So, innovative ideas creative ideas creative thinking innovation all these things is the final stage of learning that has been given by Bloom's taxonomy. So, we will be discussing this what are the components of this Bloom's taxonomy and how to how to manifest how to implement it on our primarily in our educational domain learning domain.

So, Bloom's taxonomy of learning it has been is very is very popular since 1956 onwards. In the 1956 Bloom has given this hierarchical model this hierarchical model of you know learning objectives instructional objectives primarily it is it is it is on the cognitive domain that is cognitive understanding cognitive domain. So, and it classifies the learning objective in terms of the hierarchy the difficulty level in a very you know inductive way from simple to complex also. And it has for how were the Bloom's taxonomy has 3. 3 learning domains. Gradually slowly later on it started Bloom's started this taxonomy in 1956, but later on he also developed the 2 in other 2 domains. So, it has this 3 domains of learning one is the cognitive affective that is emotional and the psychomotor that we have also already also discussed that for every activity we cannot isolate we cannot compartmentalize this cognitive effective and psychomotor separately. Because all our activity starting from receiving the information till we manifest it we perform it all our 3 domains are equally involved and engaged.

Depending on the nature of the task depending on the subject it may vary the degree may vary, but all the 3 domains are actively engaged. So, that is a 3 domains cognitive, affective and psychomotor that is the behavioral primarily behavioral manifestation behavioral domain affective is more of emotion motivation conation and cognitive is more of intellectual abilities cognitive thing. So, Bloom Bloom's Bloom's have a Bloom has also they have also he has also developed this mastery learning theory that we have already discussed that the how mastery learning theory has helped in creating suitable learning conditions and giving the clear and specific learning objectives and how to by giving the suitable conditions and clear learning objectives how can this mastery learning be achieved be attained by every learner and why we need to achieve the mastery learning because mastery learning approach actually it makes the

every learner as an individual expert in his own subject. So, there, but however, there after 2001 the this Bloom's original taxonomy has been revised by some of his core researchers core researchers core by those who were who were also initially working with Bloom they later on they restructured to revise it after a lot of you can say on analysis and debate and etcetera. So, though it is known as the taxonomy of the teaching learning assessment that means, Bloom's taxonomy revised.

So, here this is the revised taxonomy first thing is that first initial stage how to remember things and again. So, in the revised taxonomy they have also added the action components like action words action or the verbs like for example, suppose this is the hierarchy of the learning objectives then how can we measure like when we try will try to assess it measure it suppose remembering memory how can we measure it. So, we have to measure it by implementing a formulating different questions by using this action words action verbs either right for example, when we frame the question like describe relate tell these are the action words action or verb words action verbs which can through which we can measure this component this like you know every instructional objective with it has it is it has the expected learning outcome. So, how to measure the learning outcome by using or by putting the posing the questions using this action verb. Similarly for understanding so, they have mentioned they have explained they have narrated equivalent action words to measure that the measure the learning outcome or the performance outcome of this particular level of understanding level of the cognitive taxonomy.

So, here understanding for and how to and how to measure this level of understanding of the children by putting the questions like this. Similarly for every step for application for analyzing for evaluating. So, these are the actionable verbs they have attached to it through which by putting the question by making the questions by putting this actionable verbs we can really assess the outcome of this instructional objectives. So, these are the these hierarchies this taxonomy of objectives actually helps us in formulating the that is different instructional objectives. Like suppose we are starting we are beginning a subject starting a new curricular new subject in our in our institution like for example, maybe suppose a you know some suppose some pedagogical some subject like suppose a sustainable education suppose sustainable education is a thing.

So, then we have to make a you know it has a different you know pedagogical and curriculum things are the curriculum design framework is already there. So, first thing is that how to make a balance of all these three domains instructional objectives covering all the three domains cognitive, affective and psychomotor. So, accordingly we have to design the instruction suppose we are putting some few chapters on for measuring the cognitive aspects of the learners then we have to design it designs topics lesson accordingly as for this taxonomy. Similarly there are two others like the affective similarly other two affective and the behavioral psychomotor domains are also there. So, this revised taxonomy emphasizes more of a dynamic approach to using education.

So, you can say so, here to begin with we can say starting with the remember these are the action words key words through which we can pose the questions and by the end of this lesson suppose the some task some lesson for the involving only this stage remembering suppose our school education primary school education we are putting those only the questions the contents as per this level. So, by the end of the lesson the students will be able to understand these concept Newton's law these things that thing. Similarly, suppose with the progressive with the

making with the progressive development etcetera. So, understanding applying understanding applying these are the different key questions these are the different that the key questions action verbs that we can put for designing the lessons lesson for as per the level cognitive higher level of the cognitive hierarchy. Similarly, you can say here from then from applications to analyze to evaluate to create these are the they have it is the demo demo that means, the example the demo of action verbs and how to measure it what does it mean all these ways of learning objectives have been mentioned clearly in the revised Bloom's taxonomy.

Now, so, affective similarly the affective domain has come up in 1964 Bloom and his associates that has come up 1964. Similarly, the affective domain the emotion suppose we are suppose a subject like you know subject like you know literature, subject like art, some subject like philosophy, subject like music which actually which has a heavy load of affective domain the content is more of affective related to more of affective domain. Suppose like which involves more of feelings, values, appreciations, you know motivation, all kinds of things these things are gets the priority in this kind of things. So, then he has also given the hierarchy how to that means, how to develop a course content on the based on the affective domain of the or the content loaded with the emotional contents. So, here we can say to start with receiving how do we suppose listening in music suppose for example, listening in music the basic awareness and the receiving and at the beginning what are what are our observation, what are our experiences, what are our perception.

Then after receiving that stimulus that information that music then how do we respond to that, how do we react to that, how do we react to that responding. So, how do we measure the response in responses or responding stage then thereafter how much do we value it is important value of the piece of information, value of the music piece, value of value that we attached to that content. So, value of you know value of you know developing a kind of interest what are what are the value that we add to that content that is the valuing it. Then thereafter organizing after valuation then we try to for example, then we try to organize the you know whole thing into as per our priorities are we try to priorities our as because we add value to that we try to organize our you know in a better way so, that it can enhance our knowledge. So, organizing the that in sorting out the values into priorities and creating a unique value system ok, like a framework a structure like the ethical standard.

For example, when you are designing you are preparing a code of conduct ethical standard for the professionals for teaching professionals for medical professionals etcetera. So, then organizing the whole values into a structure in a in a format. Then characterizing, characterizing is the building the abstract knowledge based on the knowledge and acquired from previous styles then value system that we try to display, try to perform, try to you know embed in our system, try to practice it that is the characterization. Similarly, in psychomotor domain which is primarily related to acquisition of the skills competencies relates to skilled behavior and performances. Similarly, the psychomotor domain at model focuses primarily on the physical movement, coordination related to motor skills, competencies, masteries all kinds of things.

So, mastery of these specific skills in terms of speed, understanding, precision all these things are very important and the skills ranges from the simple task as simple as you know washing, cleaning certain things to developing a system, computer system, software, AI, AI software whatever this highest level of complex task. And this model has the 5 levels similarly the psychomotor domain has the 5 level. So, like for example, first thing is the imitation when the moment we start imitating the student when observes it, watches it, learns it then try to copies

it that is imitation. Then thereafter the manipulation then he try to explore the various things try to you know perform it, memorize it, memorize it, following the follows its instruction manipulation they try to acquire it learn it through manipulation by practicing by following instruction etcetera. Then the precision then here the performance becomes more that means, after manipulation he now he can better understand the whole system whole thinking the essence.

So, performance become more expert gradually slowly develops the expertise expertise in the sense that in the in understanding it is functions the various features, function, actions, the pros and cons and what would be the antecedents, what would be the consequences etcetera. So, make it as precise to understand its operation mechanism. Then comes articulation, articulation means with that expert knowledge then he further elaborates further they he develops different higher perform better in a better way in a more harmonious way, more skilled way, more competent way. So, skills after like for example, skills in the up to this mastery of the skills at the precision levels you can say that, but when along with the precision level skills when he add his own you know understanding any new idea knowledge out of his experience make it more harmonious, very make it very you know very comprehensive. Then add several skills can be performed together and he add some values more competencies, more knowledge, more values, more you know some kind of you know assumption, some kind of you know predictions then it becomes articulation stage.

That means, not only has acquired master the things skill, but here here can he can better explain it its pros and cons, its antecedents and consequence, it can he can present in a very novel way, very harmonious way etcetera. Then the last stage is naturalization, naturalization is complete you can see it after this articulation then complete immersive learning and complete you can say its naturalism absorption, absorption of whole thing into the system. That means, it becomes automated, it becomes inbuilt, it becomes automatic processes effortless. When the all these things become effortless that is the naturalization of the high level of performance achieved with the actions becoming the second issue. That means, it becomes more automated automatic behavior, automatic mechanism, automatic knowledge and skills and performances that is its effortless.

Now, it is already inbuilt in the system all it is there already embedded in the thought process. So, that is the this is the these are the hierarchies of this hierarchy of this psychomotor domain then. So, these are the and yes and these are there are different types of knowledge as you know we have the factual knowledge, conceptual knowledge, procedural knowledge and meta cognitive knowledge. So, factual knowledge is that factual knowledge it relates we have already discussed about the different types of memory ok. Similarly, factual knowledge it primarily relates to you know specific details, information, data, raw data etcetera.

Conceptual knowledge when it describes the knowledge some categories principle like the concepts we have formed. Similarly, conceptual knowledge at the theoretical level and the basic level, principle level, theory level, structural level what is the knowledge that we perceive or we conceptualize we understand that is conceptual knowledge. Procedural knowledge is more related know hows, how to perform, how to perform, how to complete. So, that is a skill all the skills, practices, techniques and the methods these are primarily procedure procedural knowledge and we are above that that is the meta cognitive knowledge. Meta cognitive knowledge is very often it is you know it is there in the it is that it is the you can say it is there in the inbuilt in the Bloom's taxonomy the revised taxonomy. How the individuals learns about himself, how we know about our own learning. This is basically

learning about our own learning.

So, how to learn or know our own cognition is called metacognition knowledge. Metacognition knowledge is that. Within computer science, we say that data about data is metadata. Similarly, knowledge about our own knowledge and understanding is the knowledge related to thinking and knowledge about the cognitive task, the self-knowledge, knowing our self, learning about and knowing our own learning is called metacognitive knowledge. Now, I am stopping it here. Now, in the next class, we will further explain this metacognition knowledge, metacognition, and metacognitive knowledge. Thank you very much.